Making (Electrical) Connections: Exploring Student Agency in a School in India

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ABSTRACT: Students studying in government-run schools in rural India possess much experiential knowledge of the world around them. This paper presents a narrative account of an ethnographic exploration of such students as they attempted to learn about electricity in an eighth-grade classroom in a government-run schools in a village in India. The paper shows how students having a rich experience with household electric circuits attempt, in a contingent and situated manner, to negotiate their role as students and participate in the school science discourse. The students' actions expressed agency that was contingent, situated, and aimed at selective appropriation of school science discourse for their own purposes. Such expressions of student agency indicate rich possibilities for meaningful learning of science in rural schools in India provided school science is made relevant for their lives and concerns. © 2007 Wiley Periodicals, Inc. *Sci Ed* **92:**297–319, 2008

INTRODUCTION

In all cultures, children learn about many things and phenomena outside school through their participation in activities and discourses of their communities. Because of the situated nature of these learning experiences, the experiential knowledge and discourses that children appropriate outside school would obviously vary across communities. Thus, for instance, in an American town, a middle school student may know how to navigate the Internet and how to order food through phone. The Aka children of Central Africa, on the other hand, when they are 7–12 years old, can hunt and butcher large game animals, trap porcupines, and grow food plants (Rogoff, 2003, p. 136). As documented by many researchers in different cultural contexts, see, for example, Barton and Yang (2000), Moje et al. (2004), Moll, Amanti, Neff, and Gonzalez, (1992), and Warren, Ballenger, Ogonowski, Rosebery, and Hudicourt-Barnes (2001), students' own *funds of knowledge*

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(Moll et al., 1992) about the world may or may not play a role in their science learning at school. This paper tells a story about a group of middle school students in a village school in India who could not hunt or surf the Web. Instead, through their experiences outside school they had learnt much about electricity. In this paper, I narrate how these students responded to school science discourse on electricity in their science classroom.

This paper comes out of a larger ethnographic study of science teaching and learning in the aforementioned school in India. It focuses on students' efforts to both learn and survive science as taught in that school. In another paper (Sharma, in press) emerging from the study, I look at events in the science classroom of eighth grade from the teacher's perspective. The current study is guided by a sociocultural perspective. It shows how eighth-grade students with a rich, out-of-school experiential knowledge, and ways of talking about electricity attempt to negotiate their role as students and appropriate school science discourse for making sense of their own experiences with electricity. These attempts carry message of hope as they show the rich possibilities for meaningful learning of science that these rural children can actualize if given a chance.

There have been many large-scale surveys and quantitative methodology based analyses of students academic achievement outcomes in Indian schools (Reddy, 2004). These studies have yielded important insights into the schooling of Indian kids. However, such studies are by design not intended to represent the voices of the kids and making them matter in the current discourse on the quality of education they deserve. Furthermore, studies that gauge quality of instruction in terms of students' scores on high-stakes tests, such as end of the year examinations, are not aimed at throwing much light on the complex nature of learning experiences that are jointly constructed by the teacher and taught throughout the academic year (Cochran-Smith, 2003; Kennedy, 1999). These are tasks more suited for research in the qualitative, interpretative tradition because of its ability to highlight the meaning perspectives of actors in particular events, such as those occurring in a science classroom (Erickson, 1986). Unfortunately, studies of students' experiences with schooling in India using qualitative and interpretive methodologies have a fairly recent history. There are only a handful of ethnographies, such as Sarangpani's (2003) study of constructions of school knowledge in an Indian village and Sahni's (1994) sociocultural analysis of literacy in a rural classroom in India, that have attempted to chart this research territory. Through their ability to give a "rich description" of the complex nature of teaching-learning process that occurs in science classrooms, ethnographic explorations of science learning in Indian schools can best convey and critique state's efforts to translate its educational goals, as enshrined in national policy documents and curriculum frameworks, into reality for the majority of students in Indian schools.

Such explorations of students' educational experiences in school settings have been, however, a well-traversed territory for educational researchers in America over the past 30 years, and "research has spoken increasingly to the complexity of life that goes on in classrooms" (Ball, 2002). A perspective on educational experiences of students from nonmainstream backgrounds and from a different context can then, I believe, add fresh insights and thus contribute to a richer, more nuanced understanding of science learning in school settings. Laying out the research agenda for the 21st century, Ball (2002) proposed, "ethnographic and discourse studies of local uses of oral and written language, that introduces improved instruction congruent with students' local ways of using language, and development of research-based approaches to preparing teachers for diversity" (pp. 97–98). In a larger perspective, then, this paper can be seen as following and contributing to such a research agenda.

RESEARCH QUESTION

Thus, this paper focuses on the nature and scope of student participation in a middle school science classroom of rural school in India. Taking a sociocultural perspective, I explore student participation in science classroom as engagement in a socioculturally mediated dialogue with the natural and the social world. I started the study with a broad research agenda to *understand the nature of student participation in the school science discourse on electricity.* While collecting and analyzing data, however, some salient and specific research questions emerged. From them, I discuss the following two in this paper:

1. What are the different forms of student participation in the school science discourse on electricity?
2. What are the factors that mediate a change in student participation in school science discourse?

THEORETICAL FRAMEWORK

The paper subscribes to a sociocultural perspective on how humans interact with their immediate environment. Thus, this perspective views people's engagement with their environment as mediated by cultural means, that is, tools and signs (Vygotsky, 1980). Thus, each person is seen as possessing a cultural "toolkit" of mediational means that act as a resource as well as constraint in her engagement with the world (Wertsch, 1991). Such a perspective allows me to take a discourse-centered approach to culture. That is, as Urban (1993) argues, if culture is revealed in publicly accessible signs, then actually occurring instances of discourse(s) in an event should be considered as one of the important categories of such revealing signs.

Mediational (and thus cultural) means that people use to negotiate work reveal their contingent and situated picking and unpicking of the elements of the circulating and accessible discourses. Depending upon the extant power relations and ideological positioning, a person has available to him a limited menu of circulating discourses to author her contingent response to the world. These available discourses, then in Bakhtinian terms, constitute an ephemeral and local space of authoring a response to what the world directs at the person. This authorship as Holland, Lachiotte, Skinner, and Cain (1998) aver, "is a matter of orchestration: of arranging the identifiable social discourses/practices that are one's resources . . . in order to craft a response in a time and space defined by others' standpoints in activity, that is, in a social field conceived as the ground of responsiveness" (p. 272). These circulating discourses actually act as both resources and constraints—constraining action as much as enabling it. Thus, a science classroom can be seen as a discursive site animated by several circulating discourses, such as school science discourse and out-of-school unofficial discourses that act as contingent and local resources and constraints for the teacher and students alike for engagement in the social work of teaching and learning.

Discourses present in a classroom vary in the nature of constraints and affordances they offer to a student or the teacher. Some discourses are easy to make one's own, and put to creative use. Other discourses demand conformity and rigidity, and do not submit to appropriation that easily. As Bakhtin (1981) says,

> The word in language is half someone else's. It becomes "one's own" only when the speaker populates it with his own intention, his own accent, when he appropriates the word, adapting it to his own semantic and expressive intention. . . . And not all words for just anyone submit

> equally easily to this appropriation, to this seizure and transformation into private property: many words stubbornly resist, others remain alien, sound foreign in the mouth of the one who appropriated them and who now speaks them; they cannot be assimilated into his context and fall out of it; it is as if they put themselves in quotation marks against the will of the speaker. (pp. 293–294)

Thus, both the teacher and the students, depending upon the ephemeral and shifting characteristics of a literacy event in the classroom, make a situated contingent use of the discourses available to negotiate their roles in the class.

A discursive standpoint is often seen as denying possibilities of enactment of human agency as all human thought and action are assumed to be determined by discourses (Ahearn, 2001; Cherryholmes, 1988; Erickson, 2004). That is, an individual human subject is believed to be totally "uttered" by the circulating discourses (Erickson, 2004). However, as both Erickson and Cherryholmes and some other social scientists, such as Bleiker (2003), have pointed out such a view of the influence of discourses over human life is overdetermined and overly deterministic. Thus, according to the theoretical perspective of the study, discourses underdetermine human behavior, and social action epitomizes contingent improvisation within a discursive context of constraint (Butler, 2004).

Thus, like culture, human agency too can be seen as a contingently emergent feature of situated local action. An individual does not *have* agency, but rather under opportune circumstances, she *enacts* or *exercises* agency. Taking a Bakhtinian perspective, the theoretical framework visualizes human agency in terms of a socioculturally mediated and contingently creative dialogue with the world—an engagement that not only shapes the counters and direction of the dialogue but also influences its outcome.

METHODS

The research focus of the study was dialogues-as-social action. Hence, the study was designed as ethnography of communication. By making this choice, I am essentially following a fairly established research tradition, initiated by Hymes (1964), that uses ethnography of communication as a framework for conducting and analyzing research of classroom discourse (Gee & Green, 1998; Roberta, Rampton, Leung, & Harris, 2002).

The study is situated in a village called Rajkheda, wherein I focus on students in a grade 8 science classroom of the government (public) school in the village. This village is in Narmada valley region of the state of Madhya Pradesh, India. It is a relatively poor village, with 125 families (44.4%) officially classified as below poverty line. The main occupation of the residents of the village is agriculture, and one can see agricultural fields in all directions from the village. The government middle school is the only middle school for Rajkheda and seven other neighboring villages in that region. All the names mentioned in this paper, of participants as well as of the village in which the school was located, are pseudonyms.

I am an Indian citizen who has experienced schooling in India as both a science student and science educator. Furthermore, I was also familiar with the research site and some of its participants by virtue of having worked with science teachers of schools in that area as a science educator and curriculum developer. The teacher, Mr. Raghuvanshi, whose eighth-grade science students I talk about in this paper, was known to me as I had worked with him as a science educator for a number of years. This positioned me somewhat as an ex-insider to the research setting who by virtue of experiences as a doctoral student in an U.S university had also developed perspectives and acquired descriptive labels that marked me as distinctly an outsider.

Like most other government-run schools in Madhya Pradesh, this school too is quite impoverished in terms of material and educational resources. The grade 8 classroom had 47 students sitting elbow to elbow in a small 12 × 18 ft room. The only furniture a classroom has is a table and a chair for the teacher. So the students sit cross-legged on mats, on the floor. The classrooms often have few teaching aids other than a blackboard and a box of chalk, and for many students textbooks are the only books that they ever get to read.

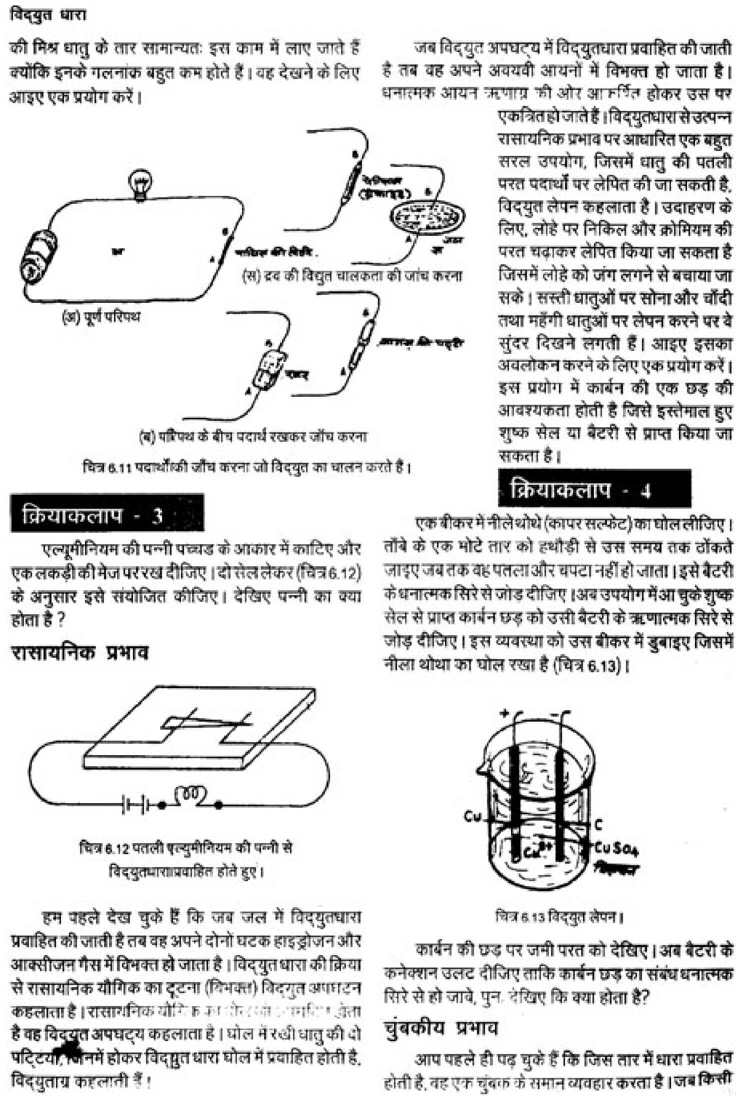
The school follows a state-mandated science curriculum that focuses on equipping students with scientific knowledge in the form of facts, definitions, and principles. This scientific knowledge is transmitted through a state-mandated science textbook for each (middle school) grade. The curriculum and the textbook make little attempt to make science relevant to the lives of the students, and rarely harness students own experiences with nature for science teaching. Besides, there is no element of inquiry or even discovery in the science curriculum. The few hands-on activities given in the textbook are to be done basically to illustrate the scientific concepts discussed in the main body of the various chapters comprising the textbook. Student learning is assessed through quarterly summative examinations that test students' abilities to memorize and reproduce official school scientific knowledge. Furthermore, the textbook is written in an arid, artificial, highly complex linguistic scientific genre that is difficult for students to understand. For instance, Figure 1 presents a page in the chapter on electricity from the science textbook, and an English translation of the section on chemical effects of electric current on that page.

Data Collection Procedures

The fieldwork for the study was done during the months of December 2004 to March 2005. After about a week of visiting the school and the village daily, I started collecting data as a participant observer in the eighth-grade science classroom of the school that was taught by Mr. Raghuvanshi. For each middle school grade, the school held one science period of 45 minutes duration (officially speaking) every day. Barring few exceptions, I observed and both audio and video recorded this science period for the eighth grade daily. For most of the days, I also sat and took notes in classrooms of other teachers for this grade. Although my theoretical lenses did influence what I treated as salient and significant, I attempted to record all the events and practices where students could be identifiably seen in a dialogic engagement with others and the material objects.

I interacted with participants in different places and contexts. Each encounter was recorded either in scratch notes or remembered as head notes. The main data categories were as follows:

1. *Ethnographic field notes:* These were composed out of my scratch, head notes, audio and video recordings resulting from (a) participant observation of eighth-grade classroom, (b) visits to students' homes and interactions with their parents and other adults, and (c) casual conversations I had with the participants inside and out of the eighth-grade classroom.
2. *Interviews:* I did loosely structured interviews with 18 students of the eighth grade as well as all the 4 middle school teachers. I audio recorded all the interviews. Initially I wanted to interview only a few students. But I found that students liked the idea of being interviewed, and thus many more students wanted to me to interview them. I am inclined to think that this was perhaps because for the first time some adult was asking them about their opinions, views, and experiences in a nonjudgmental situation. So I happily interviewed any eighth-grade student who expressed his desire. Predictably more boys than girls volunteered to talk to me.



विद्युत धारा

की मिश्र धातु के तार सामान्यत: इस काम में लाए जाते हैं क्योंकि इनके गलनांक बहुत कम होते हैं। यह देखने के लिए आइए एक प्रयोग करें।

(अ) पूर्ण परिपथ

(स) द्रव की विद्युत चालकता की जांच करना

(ब) परिपथ के बीच पदार्थ रखकर जाँच करना

चित्र 6.11 पदार्थों की जाँच करना जो विद्युत का चालन करते हैं।

क्रियाकलाप - 3

एल्यूमीनियम की पन्नी पच्चड के आकार में काटिए और एक लकड़ी की मेज पर रख दीजिए। दो सेल लेकर (चित्र 6.12) के अनुसार इसे संयोजित कीजिए। देखिए पन्नी का क्या होता है ?

रासायनिक प्रभाव

चित्र 6.12 पतली एल्युमीनियम की पन्नी से विद्युतधाराप्रवाहित होते हुए।

हम पहले देख चुके हैं कि जब जल में विद्युतधारा प्रवाहित की जाती है तब वह अपने दोनों घटक हाइड्रोजन और आक्सीजन गैस में विभक्त हो जाता है। विद्युत धारा की क्रिया से रासायनिक यौगिक का टूटना (विभक्त) विद्युत अपघटन कहलाता है। रासायनिक यौगिक [illegible] होता है वह विद्युत अपघट्य कहलाता है। घोल में रखी धातु की दो पट्टियाँ, जिनमें होकर विद्युत धारा घोल में प्रवाहित होती है, विद्युताग्र कहलाती हैं।

जब विद्युत अपघट्य में विद्युतधारा प्रवाहित की जाती है तब वह अपने अवयवी आयनों में विभक्त हो जाता है। धनात्मक आयन ऋणाग्र की ओर आकर्षित होकर उस पर एकत्रित हो जाते हैं। विद्युतधारा से उत्पन्न रासायनिक प्रभाव पर आधारित एक बहुत सरल उपयोग, जिसमें धातु की पतली परत पदार्थों पर लेपित की जा सकती है, विद्युत लेपन कहलाता है। उदाहरण के लिए, लोहे पर निकिल और क्रोमियम की परत चढ़ाकर लेपित किया जा सकता है जिसमें लोहे को जंग लगने से बचाया जा सके। सस्ती धातुओं पर सोना और चाँदी तथा महँगी धातुओं पर लेपन करने पर वे सुंदर दिखने लगती हैं। आइए इसका अवलोकन करने के लिए एक प्रयोग करें। इस प्रयोग में कार्बन की एक छड़ की आवश्यकता होती है जिसे इस्तेमाल हुए शुष्क सेल या बैटरी से प्राप्त किया जा सकता है।

क्रियाकलाप - 4

एक बीकर में नीले थोथे (कापर सल्फेट) का घोल लीजिए। ताँबे के एक मोटे तार को हथौड़ी से उस समय तक ठोंकते जाइए जब तक वह पतला और चपटा नहीं हो जाता। इसे बैटरी के धनात्मक सिरे से जोड दीजिए। अब उपयोग में आ चुके शुष्क सेल से प्राप्त कार्बन छड़ को उसी बैटरी के ऋणात्मक सिरे से जोड़ दीजिए। इस व्यवस्था को उस बीकर में डुबाइए जिसमें नीला थोथा का घोल रखा है (चित्र 6.13)।

चित्र 6.13 विद्युत लेपन।

कार्बन की छड़ पर जमी परत को देखिए। अब बैटरी के कनेक्शन उलट दीजिए ताकि कार्बन छड़ का संबंध धनात्मक सिरे से हो जावे, पुन: देखिए कि क्या होता है?

चुंबकीय प्रभाव

आप पहले ही पढ़ चुके हैं कि जिस तार में धारा प्रवाहित होती है, वह एक चुंबक के समान व्यवहार करता है। जब किसी

Figure 1. The page of the textbook from which the text translated below was taken.

Translation of text in Figure 1:

Chemical Effects

We have seen before that when electric current ("vidhyut dhara") is passed through water, it dissociates ("vibhakt") into its two components ("ghatak") Hydrogen and Oxygen gas. The dissociation ("vibhakt") of chemical compounds ("rasayanik yougik") by the action of electric current ("vidhyut dhara") is called electrolysis ("vidhutya apghatan"). The chemical compound ("rasayanic yougik") solution that dissociates ("apghatith") is called an electrolyte ("vidhutya apghataya"). The two metal plates that are immersed in the solution, through which electric current ("vidhyut dara") flows in the solution, are called electrodes ("vidhyutagra"). When an electric current ("vidhyut dhara") is passed ("pravahit") through an electrolyte ("vidhutya apghataya"), it dissociates ("vibhakt") into its constituent ions ("avyavi ion"). Positive ions ("ghanatmak ion") get attracted ("akarshit") and flow ("pravahit") toward cathode ("rinagra"), and get deposit ("ekatrit") there. A very easy use of chemical effect (rasaynik prabhav") of electric current ("vidhyut dhara") through which objects can be covered with a thin layer of metal is called electroplating ("vidhyutiya lepan"). For example, a layer of nickel and chromium can be put on iron so that it does not rust. Putting a layer of gold and silver on cheap metals and expensive articles can make them look beautiful. To observe this, let us do an experiment. This experiment needs a carbon rod which can be procured from a used cell or battery (Vigyan: Kaksha 8, 2004). (This section is then followed by a suggested activity showing electroplating of copper on carbon rods.)

3. *Student artifacts:* Science notebooks and examination answer copies of focus students.
4. *Other artifacts:* Science textbooks, administrative and policy manual for the teachers.

Data Analysis Procedures

In alignment with the research question and theoretical framework, a communicative event was chosen as the basic unit of analysis—an approach akin to "eventalization" that Foucault attempted in his efforts to understand discursive practices (Foucault, 1988). Hymes too recommended a communicative event as the basic unit of analysis for ethnographies of communication as it enabled a researcher to unravel and understand the "patterning of communicative behavior" in a *speech community*, a sociocultural group that in the theoretical framework of this study would be more appropriately recognized as a discourse community (Saville-Troike, 1989).

Following Saville-Troike (1989, p. 27), I define a single event "by a unified set of components throughout, beginning with the same general purpose of communication, the same general topic, and involving the same participants, generally using the same language variety, maintaining the same tone or key and the same rules for interaction, in the same setting." Furthermore, defining the boundaries of a communicative event Saville-Troike says, "An event terminates whenever there is a change in the major participants, their role-relationships, or the focus of attention. If there is no change in major participants and setting, the boundary between events is often marked by a period of silence and perhaps change of body position" (p. 27).

The classroom data set for this paper comes from six science periods in which the main topic was electricity. These six science periods were first broken into 281 different communicative events. Thereafter, each communicative event was analyzed at two levels. First, I looked at how students responded to the official agenda of the class, the teacher's implementation of the official agenda, and his response to students' actions. Next, I analyzed the nature of students' utterances in terms of the knowledge and discourses used by them, science topic, the exigencies that led to their utterances, and the effect their actions had on the classroom discourse. The subsequent steps in analysis included writing analytic memos, identification of themes, focused coding, and writing integrative memos (Emerson, Fretz, & Shaw, 1995). Finally, following the advice of Emerson et al. (1995) and Foley (2002), rather than presenting a tightly organized analytical argument in a "scientific ethnographic realist narrative style," the results of the study have been written as an analytically thematized narrative tale in a "more reflexive realist narrative style."

RESULTS

Analysis of data revealed patterns in how students participated in school science discourse on science topics related to electricity. These patterns connect students' participation in science periods with their lives outside school. To understand these patterns, it would be useful to first get some idea about students' experiences with electricity in their daily lives outside school.

Students' Daily Life Experiences With Electricity

Most kids in Mr. Raghuvanshi's class, especially those belonging to poorer families, led a pretty busy life as productive members of the local village economy. Before and after school, they helped their parents at home, farmland, and/or in their family profession. For

instance, Raj, who came from a family of landless agriculture workers, told me that he was then helping his parents harvest sweet potatoes from an agricultural farm they had taken on contract from the landowner. During forthcoming vacations in the summer, he planned to join his uncle to work as a wage laborer at a brick-making factory close by. As a result of their active engagement with paid and unpaid work at home and workplace, most students of eighth grade had accumulated years of experience of working with many material objects and phenomena relevant to their daily lives. They also had closely observed adults working with them as legitimate peripheral participants in native discourses surrounding them.

To some extent, I expected students in such a rural setting to be having such rich experiences with farming, cattle and cooking, and a situated yet functionally powerful everyday knowledge about the material world that arose out of such experiences. What I had not expected was to find that students in eighth grade, especially boys, also had extensive experiential knowledge of high voltage (220 volts) AC electricity and electrical appliances. Their knowledge could not have had its source in school science as it did not provide students with any opportunities to explore AC electric circuits. The source, as I discovered, was the important role of household electric lines and appliances in their daily lives. The village had electricity. Electric bulbs lit the homes of even the poorer denizens, TV sets and music cassette players were not uncommon, and electricity-run pumps were used to draw water from wells for irrigation of agricultural fields. Villagers needed electricity, and it was available, at least for a few hours everyday. However, it was also costly for many families. Besides, electricity consumed is rather laxly monitored by state electricity boards in India. Thus, I found that using electricity by making an illegal "direct connection," as villagers called it, to the nearest power cable was common. This is a rather widespread phenomenon in India. Studies on India's power sector show that as much as 21% of the electric power generated in India got lost during transmission and distribution of electricity (Dossani, 2004), and as much as 37% of reported electrical consumption in the rural areas may be contributing to this extraordinary transmission and distribution losses in India (Kannan & Pillai, 2000). Thus, many students through apprenticeship of observation and by trying it themselves had learned out to make such "direct connections" safely.

Their deep experiential knowledge about making such potentially dangerous high-voltage connections got revealed to me during one freewheeling discussion I once happened to have with a bunch of students in their classroom. The fact that there was no teacher in the class then and students were largely left to themselves, probably encouraged them to participate more freely than usual. During this conversation, I asked them if they knew how "direct connections" are made to get electricity from electric poles. Raj said yes. I then asked if he could draw a diagram to show me how that is done. Using a page of my notebook and with helpful suggestions from other students, Raj drew a diagram in my notebook, and explained how wires are connected to the electric lines between the poles, where switch is placed, how "joints" are made in wires, and how one wire is connected to the ground for "earthing" (Figure 2). As he drew, he also told me in detail how a wire is "earthed"—the pit that is dug and the chemicals (water, coal, and salt) that are put into it along with the wire attached to an iron rod. He and other students sitting there were aware that not all electric lines carry current—two carry "phase," but one is earth line. Raj thought that one wire was of "phase," and the other did not carry current. But when I asked him about the third wire, he did not know for sure, but told me that two wires were of use, and the third one was not. Ganesh thought that two carried current, and one did not. Ganesh also told me how electricity can be brought to a house through two types of circuits one with "earthing," although without a switch and one without "earthing," that is, by simply connecting the two ends of the connection to the two phase wires. To explain his circuit, he drew the circuit diagrams in the space below Raj's diagram (Figure 2). I asked Raj whether Ganesh was

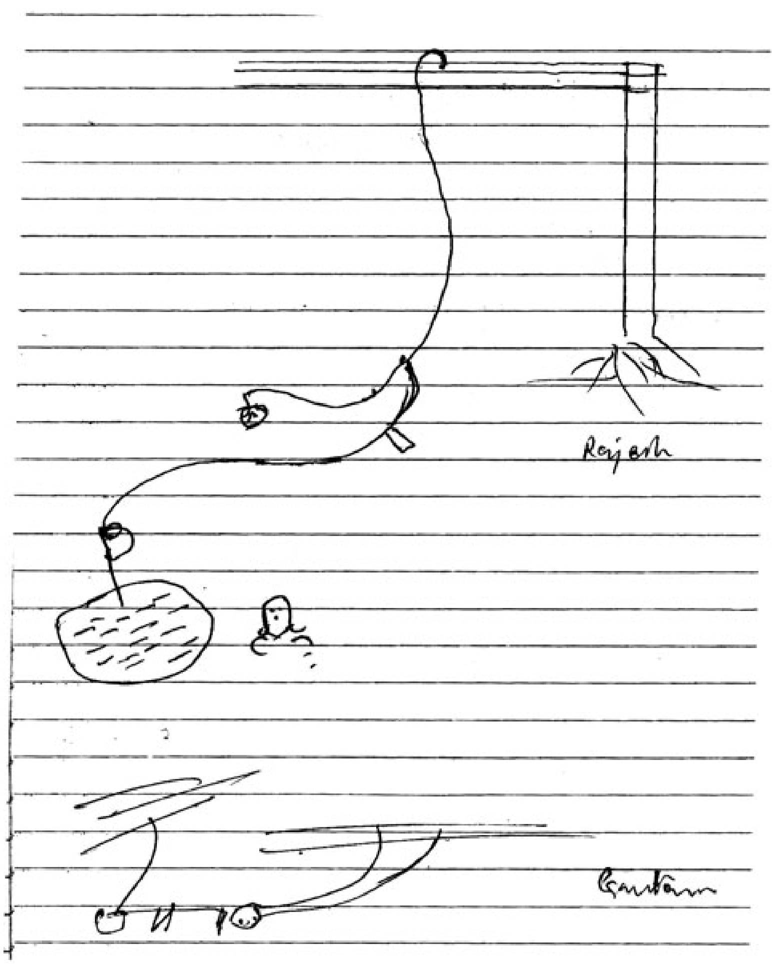


Figure 2. Circuit diagrams showing "direct connection."

right. He said yes. Ganesh also said that if connections were made to just one line, then bulb would not light. It would light only when connections were made to different lines. I learned from them that most houses in Rajkheda village get electricity this way.

Students, especially boys, were also able to do simple repairs of electrical appliances, often using soldering iron to accomplish their job. For instance, Praveen told me, "If somebody in the village comes, then I do 'welding-shelding' and using 'ranga' (solder) can 'solder-volder' things."[1] As I learned, many times their knowledge arose from having to solve a problem in their household circuits and appliances all by themselves. As Deepak told me, "Sir, we have a tube well, when its fuse blows up, I have to go to repair it." Repairing a fuse in a 220 volt AC current is dangerous, but not that complicated. One just has to replace the burnt-out fuse wire with a new one. Sometimes, however, the problems required more complex working knowledge of AC current and circuits. For instance, Deepak told me how he once repaired a fan that was not working. I reproduce the conversation we had:

[1] It is common usage in Hindi to add a rhyming (nonsensical) word at the end of nouns and action verbs. Thus, welding in Praveen's sentence was uttered as "welding-shelding" and solder as "solder-volder."

Communicative Event No. 1:

1. Deepak: No sir, what happened once was . . . there was a "fault" in the wire.[2] So, I checked it with, what do you call it . . . a ("series") . . . it was a long wire . . .
2. Me (Interrupting): What? What did you use to check?
3. Deepak: Sir, don't we call it . . . a "tester."
4. Me: Oh, yes, right, right.
5. Deepak: So I checked the wires with it . . . where the "cut" in the wire was . . . it was lighting there, but was not lighting in the other wire. Then I checked in the middle, it was not lighting up, so I replaced that bit of wire, and it started working.

Thus, we see in this conversation, how Deepak when confronted with the problem of a nonworking fan figured out the problem through a "tester" and solved it by repairing the gap in the circuit. Students also got to learn about electrical circuits from the adults in their family and village. As Raj told me, "When people in my locality repair electricity, then I usually observe them. If somebody opens a TV, and repairs it. Then I observe that too, and learn which wire is connected to where . . . "

As these examples show, students through active participation in daily events and activities in the local village economy and their homes had accumulated a rich experience of working with plants, domestic animals, and inanimate objects and phenomena. This experience yielded them a robust and functional knowledge of the world around them—a crucial discursive resource that they brought with them to Mr. Raghuvanshi's science class.

Forms of Students' Participation in the School Science Discourse

As mentioned in the methods section, to evaluate how students participated in the classroom discourse and responded to school science, I took a communicative event in Mr. Raghuvanshi's science class as the basic unit of analysis, and analyzed a total of 281 events that occurred in six class periods in which electricity was the main topic. As I show in the following, analysis of these communicative events reveals patterns that help us understand the different ways in which students with all their knowledge and experience of and interests in the material world negotiated their role as students and responded to school science discourse in Mr. Raghuvanshi's classroom.

Mr. Raghuvanshi's class had a predictable familiar daily rhythm to it. Almost every day, the science class started with roll call of students. First, homework of students who volunteered to show was checked while rest of the class waited. The teaching began shortly thereafter and almost always ended with the giving of homework to students. The learning environment in Mr. Raghuvanshi's class was remarkably relaxed, especially if we compare it with that of other subjects. Students felt freer to participate not only in classroom discussions but also in the discursive underlife. Mr. Raghuvanshi did not spend much time in managing the students overtly. He tolerated students' sidebar conversations as long as they did not threaten to overwhelm events related to classroom discourse. Furthermore, Mr. Raghuvanshi actively encouraged students' participation in the classroom. However, despite all the encouragement by the teacher, students responded to the classroom discourse contingently, calibrating their responses in accordance with the constraints and affordances of the social situation of the moment. The major categories of their response as emerging from the sociolinguistic discourse analysis of the communicative events are summarized in Table 1.

[2] Words in quotes were English words spoken by Dinesh. The rest of the dialogue was in Hindi. I have used standard conventions for presentation of audio transcripts. Square brackets ([]) denote overlapping speech by two or more speakers. = indicates that the speech by one speaker is continuous from one = to the next. An underline indicates a stressed word. . . . indicates a pause in speech.

TABLE 1
Student Participation in Science Periods When the Topic Was Electricity

Category of Events	Frequency
Events with students taking initiative on science content	54
Events with students responding to teacher instructions and questions and conforming to the official agenda	165 (in 90 events students use out-of-school discourses and their experiential knowledge)
Events with students taking initiative to inject a noncontent related element in the classroom discourse	14
Events with students conducting unofficial sidebar conversations in the classroom	38
Events with students responding to teacher instructions and questions with a noncontent related response	7
Events with teacher taking initiative to talk on nonscience related issues	3
Total events examined	281

Students as Passive Learners. As Table 1 reveals, for much of the class time, I found that students sat in the class rather passively either listening to Raghuvanshi or participating in the teacher-centered I–R–E (initiation–response–evaluation) exchanges or classroom activities as instructed by him (about 59% of the 281 events for which the science topic on the official agenda was electricity). Except through compliance, there was little evidence of student initiative to influence events pertaining to teaching-learning of science. As a result, teacher–student dialogue unfolded more or less according to Mr. Raghuvanshi's instructions.

However, even while following the teacher's lead, students acting like bricoleurs made use of whatever resources, in the form of discourses, they could access to negotiate their relatively passive role in the classroom dialogues. Thus, I found that in as many as 54% of the communicative events where students did not show any science content related initiative, students brought in out-of-school unofficial discourses and their own experiential knowledge of the material world to respond to the teacher's questions, comments, and instructions. Analysis of these events showed that in all of them the science topic under discussion was directly related to experiences with electricity that most students had in their daily lives outside school. Students' out-of-school discourses and knowledge were relevant and thus could be made use of while negotiating their roles as students.

For instance, consider the event given below that occurred while Mr. Raghuvanshi was teaching about different types of electric batteries. He had made a table on the blackboard, and with the help of students was filling it up with the names of electrolytes, the positive and negative electrodes of different types of batteries. Mr. Raghuvanshi had allowed students to take the help of their science textbooks to answer their teacher's questions. However, most students were familiar with large storage batteries, like those used in car and trucks. They were used as backup power sources for some of their home appliances, such as televisions and music players. Routine maintenance of these batteries was generally done by the villagers themselves. Now, in this event, while filling the row for storage cell, Mr. Raghuvanshi asked the students the electrolyte for this type of battery. For a while no student hazarded a guess, so Mr. Raguvanshi asked again, and a dialogue ensued as follows:

Communicative Event No. 2:

1. Raghuvanshi: OK! So what do we put in the batteries that you have in your homes?
2. Students: Sir, *tejaab*.
3. Raghuvanshi: Which one?
4. Another student: "acid."[3]
5. Raghuvanshi: Yes, "acid," but which one?
6. Students: *Tejaab*.
7. Raghuvanshi: Now, *tejaab* is a Hindi word. In English it is called "acid." There are hundred different types of acid, so which "acid?"
8. Bharatjee: Liquid.
9. Raghuvanshi: Anything like water is called liquid. Water is also a liquid. Milk is also a liquid. But what is in a voltaic cell?
10. A student: "Sulfuric acid."
11. Raghuvanshi: "Sulfuric . . . ?"
12. Students: "Acid."

The science textbook uses the Hindi scientific term *amla* to refer to acids. However, as we see in this event, even though students were allowed to take the help of their science textbook, when asked about the liquid they pour in the electric batteries they used at home, the students chose to respond (Turns 2 and 4) by using the local vernacular terms for acid—*tejaab*, and "acid." Again when Mr. Raghuvanshi wished to know (Turn 9) which acid was used in a voltaic cell, students used the English term "sulfuric acid" that is more common in the local out-of-school discourse on electricity rather than the Hindi scientific term "gandhak ka amla" used in their science textbook. Their out-of-school discourse on electricity was handy in this dialogue, and thus was used by the students.

However, as we see in the event given below, when the science topic had little bearing with their experiential knowledge about electricity, neither did students take any initiative in making an unsolicited comment or asking a question about the science topic, nor did they bring in any discourse or knowledge from out of school to negotiate their conformal role as students. This event occurred when the topic being taught was electricity generation, and students were learning about solar cell—something they had read about only in their textbook.

Communicative Event No. 3:

1. Raghuvanshi: Here we have the solar "cell."[4] What happens in the solar "cell"? In the solar "cell," which energy got converted? . . . Light . . . Does light have energy too or not?
2. Students: Yes sir.
3. Raghuvanshi: So in a solar "cell," light energy gets converted into electrical energy. Now write this completely. (Speaking slowly so that students can copy) In a solar "cell," light energy gets converted into electrical energy . . . . OK? But in these three batteries, do they have light energy?
4. Students: No sir.
5. Raghuvanshi: Light has no role here. In them, it is the chemical energy that gets converted . . . What is it getting converted into?
6. Students: Electricity.

[3] Words in quotes were English words spoken by the participants. The rest of the dialogue was in Hindi.
[4] Words in quotes were English words spoken by the participants. The rest of the dialogue was in Hindi.

As the reader must have noticed, in this event it is the teacher that does most of the talking (Turns 1, 3, and 5), while students limit their role to answering teacher's rhetorical questions in as few words as they could (Turns 2, 4, and 6). Students' own out-of-school discourses were not relevant in this communicative event, and thus students could not use them to participate in the class dialogue. School science discourse was hard to appropriate, and thus I also did not find much evidence of students using it to facilitate their participation in classroom discussions. Thus, as we see in this event, students often chose to accomplish the social work required of them as students by being passive conformal bodies.

Students as Agents. However, conformity was not the only way students related to the classroom discourse. As I show later, whenever the constraints and affordances of the local context and the resources at their disposal made it feasible, they did the local work of participating in classroom activities a bit differently. Thus, during my stint in the classroom, I also got to see many events when, overcoming their fears and misapprehensions, students took initiative in class by asking unsolicited content-related questions or making comments that influenced the ongoing dialogue, often taking it into contingent and unscripted directions. As Table 1 shows, of the total 281 events analyzed, in about 19% of them clear evidence of such student action was found. These initiatives were mostly in the form of unsolicited comments by a student on the science topic being discussed. However, sometimes students also sought to influence the classroom dialogue by asking questions to the teacher. During my entire fieldwork only once did a student initiative come in the form of a suggestion for an activity. But the topic for this initiative was plants and not electricity.

Factors That Mediated Change in the Nature of Student Participation in School Science Discourse. As we saw above, students varied their stance toward school science discourse considerably across different science periods while learning about electricity. Although not aspiring to do a strictly causal analysis, I nevertheless wished to understand the factors that mediated or contributed to a change in the nature of student participation in the classroom dialogues on electricity. Thus for each event, I analyzed the nature of students' utterances in terms of the knowledge and discourses used by them, science topic, the exigencies that led to their utterances, and the effect their actions had on the classroom discourse. The analysis threw up following prominent themes that were showed themselves in other science topics as well.

The Nature of Science Topic. From reading fieldnotes of Mr. Raghuvanshi's classroom, it was clear to me that the nature of student response to school science very much depended upon the science topic being discussed in the classroom. Thus, desiring to get a glimpse of the sort of science topics interest these students or are amenable for student initiative, I content-analyzed all the events that showed student initiative as well as those where students chose to conform to the teacher's instructions and intentions. The content-analysis reveals that students took initiative when the main science topic for consideration in the class revolved around issues of electrical safety, conductivity of electricity through different materials, working of an electrical circuit, and electrical lamps. These are all those topics that students, especially boys, had to grapple with in their daily lives as young working adults in farming families. In contrast, I did not find students taking initiatives in electricity topics such as electroplating (chemical effects of current), different kinds of batteries, solar cell, dynamo, and electrical charge. I found a similar pattern in other school science topics, such as plants, chemical properties of metals, and energy generation. For instance, even in plants, something that is closely connected with their everyday existence as farmers,

students take initiative mostly in discussions that they could relate to, such as different types of leaves and plants found in the area. But, when Mr. Raghuvanshi discussed how leaves of aquatic plants adapt themselves to their aquatic habitat, students showed little science content related initiative, and played their part in teacher initiated I–R–E (initiation–response–evaluation) exchanges. Obviously, students' engagement with school science did not just vary in terms of the science topic but also, and equally importantly, in terms of the intended purpose of their engagement. To understand what students were trying to accomplish in events where they took agentive action, I analyzed such events in terms of exigencies that led to that action and its intended purpose. Two factors that mediated student engagement with school science emerged from this analytic exercise. A discussion of these factors follows next.

Opportunity to Make Connections. Students seemed eager to connect school science with their lives outside school. As discussed above, this desire manifested itself mostly in topics, such as household electric circuits, that bore any relation to students' lives outside school. On these topics, I found students taking action to make school science relevant to their experiences outside school, and by bringing in and dialogizing their out-of-school discourse on electricity with school science.

To illustrate this trend I present below a lengthy dialogue that happened when the class was discussing safety precautions for household circuits. As was not uncommon, the event began with an invitation for participation by the teacher as follows:

Communicative Event No. 4:

1. Raghuvanshi: So is there anything we can do to avoid this danger? If there is too much current, then wires in our homes get hot . . . There was no "fault."[5] But because of too much current what happens is that . . .
2. A student: A "fault" occurs.
3. Raghuvanshi: No, the wire melts. Right?
4. Students: Yes sir.

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.
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5. Raghuvanshi: So what can we do to avoid this danger? If there is too much current . . . it happens sometimes.
6. Bhola: "Fuse wire," sir. Of low melting point.
7. Raghuvanshi: Yes, we should use a fuse wire of low melting point. So tell me, is he correct in saying this?
8. Narendra: Yes, sir.
9. Raghuvanshi: Can we use any "fuse wire," and from anywhere?
10. Students: NO SIR.
11. Raghuvanshi: So, of what type?
12. Students: Of low melting point.
13. Raghuvanshi: Of low melting point, and of precisely the gauge that is needed there.
14. Students: Yes sir.
15. Narendra: Sir, what if someone has a "direct connection"?
16. Raghuvanshi: Even if there is a direct connection, then also you can think of some solution. That is, if you connect wires directly, what precautions need to be taken?

[5] Words in quotes were English words spoken by the participants. The rest of the dialogue was in Hindi.

In this event, we find Mr. Raghuvanshi initiating an animated dialogue (Turn 1) on how fuse wires keep homes safe from electrical fires, "faults" and other dangers. Fuse-wire-based protection is usually installed by the local electricity board while installing a legal electrical connection in a house or a farm. However, since many homes in the villages of this region get their electrical connection illegally directly from the electric poles, fuse wires were not a very relevant form of protection for the people in the surrounding villages. Although, since using an illegal "direct connection" was fraught with risk of electrocution, the issue of electricity safety was an important issue in the lives of the people. Finding that the discussion was proceeding in a direction not very relevant to the lives of the students, Narendra took corrective action (Turn 15) by asking Mr. Raghuvanshi, "Sir, what if someone has a *direct connection*?" Everyone in the class, including Mr. Raghuvanshi, apparently knew what this phrase in English meant. There were no explanations sought or given on what Narendra meant by "direct connection" and why he asked this question. Mr. Raghuvanshi perhaps sensing the importance of this question for the lives of the students, and also recognizing that students may have much to say on this issue, revoiced the question back to the students. As the subsequent event I describe below shows, Narendra's action once legitimized by Mr. Raghuvanshi was immediately taken up by other students. Thereafter, the ongoing dialogue charted an unscripted direction guided by contributions from the students. In this way, Narendra's action succeeded in making a school science topic relevant to the lived experiences of the students and their families. The local emergent contingencies of a science topic, viz. electrical safety, related to students' lives, teacher's invitation (Turns 1, 5, 7, 9, and 11) for student participation, and accessibility of unofficial, out-of-school discourse about electricity for Narendra created favorable conditions for expression of student agency aimed at more enriched learning of science.

Thus, once Narendra's initiative centered the topic of electrical safety away from the decontextualized conceptualization of school science to the situated lived realities of "direct connection," classroom discussion proceeded in an unscripted yet productive manner. I present the subsequent dialogue to highlight the way students, under opportune conditions, made use of their out-of-school discourse and experiential knowledge of electricity to appropriate school science discourse and connect it with their everyday experiences with electricity.

Communicative Event No. 5:

1. Raghuvanshi: Come on tell us what needs to be done to avoid this danger if wires are connected directly?
2. A student: Sir, we should connect a "grip" to the wire.[6]
3. Raghuvanshi: <u>What</u> should be connected?
4. Students: "GRIP"!
5. Raghuvanshi: "Grip," or what you also call the "cut-out." Or "main switch."
6. Narendra: Sir, we can also connect an "MCB."
7. Raghuvanshi: There is a fuse wire in the "cut-out."
8. Students: Yes sir.
9. Raghuvanshi: What?
10. Students: An "MCB."
11. Raghuvanshi: M-C-B. It is a new thing that has come recently that is used in place of cut-out or fuse wire. It is called . . .
12. Students: M-C-B.
13. Raghuvanshi: What does it do?

[6] Words in quotes were English words spoken by the participants. The rest of the dialogue was in Hindi.

14. Yashwant: Sir, if there is too much "current," then it "trips."
15. Raghuvanshi: Yes, it "trips." That is, it stops the "current" on its own.
16. Yashwant: And, sir, if someone gets a shock then also it "trips."
17. Raghuvanshi: Are you all listening?
18. Bhola: Yes sir.
19. Raj: Sir, another new thing has come . . . "Auto."
20. Ramesh: Oh that! That has been long in use.
21. Raghuvanshi: "Auto"?
22. Jagdish: ( )
23. Raghuvanshi: One minute! Let him speak. Go on.
24. Raj: Sir, it is used in "tube-wells." It is used in "starter" that is used to start tube-wells. If "light" comes, it allows tube-well to start automatically, so that we don't have to go near the "starter." But if "light" is low, it wouldn't start.[7]
25. Raghuvanshi: So if there is enough "light," it would start on its own. And if it is low then . . .
26. Students (and Raghuvanshi): It would shut-off.
27. Raghuvanshi: So if the motor is on, and if there is a drop in "current," then . . .
28. Raj: Sir, that thing will automatically shut the "motor" off.
29. Raghuvanshi: Yes, so it also stops the "engine" on its own. . . . So there is a new thing now. What would we call it? . . . "Auto" . . . "Auto switch"?
30. Raj: Yes, "auto switch."

As we see above once Narendra managed to make school science relevant to their lives outside school, students came forward to dialogize school science with their out-of-school discourse and experiences with electricity. Thus, Narendra and Raj took initiative (Turns 6 and 19) to inform Mr. Raghuvanshi and other students about advanced electrical switches—"MCB" (multiple circuit breaker) and "auto switch." The science textbook that Mr. Raghuvanshi was following in his teaching sequence that day does not mention about any safety precaution other than fuse wire. While covering this topic, Mr. Raghuvanshi only talked about fuse wires for electrical safety. It was students who by taking initiative to about MCB and "auto-switch" influenced the ongoing dialogue to proceed in a direction closer to their lives and interests. Evidently, it was not just these two students who knew about these appliances. It appears to be common knowledge because when Mr. Raghuvanshi asked Narendra to repeat the name of the equipment he had mentioned many students spoke (Turn 10) at the same time to repeat the name of the equipment. Similarly, when Raj informed the class about "auto-switch" and claimed that it was a new thing. Ramesh countered it (Turn 20) by asserting, "That has been long in use." Making good use of circulating nonofficial out-of-school discourse about electricity, the students explained (Turns 2, 6, 10, 14, 19, and 24) how these safety features worked heavily borrowing English scientific terminology, such as current, tripping of electrical circuits, light, starter, auto-switch, and MCB. Students' explanations also show how well the students had understood how these advanced electrical devises worked. Analysis of communicative events shows that this robust working knowledge of electricity manifested itself frequently in students' utterances in the classroom discourse whenever the electricity topic was connected to their lives outside school.

Seeking Coherence. Another factor that mediated a change in student participation from passive conformity to agentive action was a desire to seek coherence in their accounts of everyday phenomena. That is, I found that students also took initiative when school

[7] In local vernacular, "light" meant electricity flow in household circuits. This is because in olden days when the use of electrical appliances was scarce, electricity was largely used for lighting bulbs only.

science appeared to contradict or say something different about the material world from what students had learned from their outside school experiences and immersion in other discourses. The following event illustrates this trend in student initiatives. This event occurred during a science period where the main topic was the two types of electric current—alternating (AC) and direct (DC). Prior to this event, Mr. Raghuvanshi had discussed with the class how two types of electricity were used in their houses and how appliances that run one type of electricity do not run on the other. The class had also discussed the use of "eliminators" to convert AC to DC, and how magnitude of current in one remains constant while in the other undergoes repeated cyclical changes.[8]

Communicative Event No. 6:

1. Narendra: Sir, we get a shock from the current on poles, and don't get shock from the battery current.
2. Raghuvanshi: So don't you get a shock form the current from a battery?
3. Students: No sir.
4. Narendra: That is just 12 volts.
5. Raghuvanshi: You don't get the shock because it is just 12 volts. If it becomes 60 or 100 volts, then with it too you will feel a [shock] =
6. Students: [Yes sir].
7. Raghuvanshi: = because the electricity from poles is 220 volts.
8. Narendra: Sir, why then we don't get a shock when we touch the wires after it passes the "eliminator"?[9]
9. Raghuvanshi: Eh?
10. Narendra repeats the question.
11. Raghuvanshi: In the "Eliminator"?
12. Students: Yes sir.
13. Raghuvanshi: "Eliminator" means that it reduces the current .... It makes 220 volt current into a 12 or 6 volt current. It changes the current, it makes it DC ... and reduces it too. It does two things. It makes a "cell" like current.

Although Mr. Raghuvanshi had covered major differences between AC and DC, he had neglected to address one important difference between AC and DC that students saw in their daily lives. And that is, AC gives electrical shock, but DC seemingly does not. It is easy to see how someone may develop this naïve conception since only low-voltage DC is used in household circuits whereas only high (comparatively) high-voltage AC is used in homes. In this event, Narendra took initiative (Turn 1) to help Mr. Raghuvanshi address this naïve conception. He also supplied his own (correct) interpretation (Turn 4) that battery current did not give shock as it was "just 12 volts." Now, while talking about invertors, Mr. Raghuvanshi had not mentioned that eliminators, apart from converting AC to DC, also reduced the voltage of the current. By skipping this crucial bit of information, Mr. Raghuvanshi had unwittingly created an apparent contradiction about AC and DC, and their capacity to inflict electrical shock on people. That is, if eliminators only converted AC to DC, and the possibility of electrical shock was dependent upon the voltage of the current, then the DC current coming out of an eliminator should have the same voltage as AC and thus, the same capacity to inflict electrical shock to people touching naked wire inadvertently. But that as at least Narendra had realized does not happen. Hence the

[8] A household AC/DC converter or adaptor is commonly called by an English term "eliminator" in the Hindi language in India.

[9] Words in quotes were English words spoken by the participants. The rest of the dialogue was in Hindi.

contradiction. Narendra brought up this contradiction for resolution (Turn 8) by asking Mr. Raghuvanshi, "Sir, why then we don't get a shock when we touch the wires after it passes the "eliminator?" Narendra's intervention clearly influenced the ongoing dialogue and took it into a direction more relevant to daily life experiences of students with electrical appliances. Thus, here again, we see a situated expression of student agency aimed at critically influencing the direction and nature of learning about science in classroom.

Availability of Out-of-School Discourse and Experiential Knowledge of Electricity. As the examples of classroom dialogue given above show, availability of out-of-school discourse was also a crucial factor in mediating changes in participation of students in the school science discourse. In all the 54 events (refer to Table 1) that had students taking initiative to influence the nature and direction of classroom dialogue, it was the out-of-school discourse on electricity that was leveraged by the students to make their agentive action possible. For instance, in the communicative event (no. 5) in which students talk about different electrical safety measures, such as "grip" and "MCB," it is difficult to imagine how students could have taken control over the dialogue if they did not have access to experiential knowledge and ways of talking about safety precautions to take in case of "direct connection." The science textbook did not talk about any safety measure other than fuse wires. But the students from their experiences with household electric circuits knew about many other safety measures, such as multiple circuit breakers and auto-switches. As we see in this dialogue, students used this resource effectively to change the nature and direction of the dialogue. Similarly, consider the communicative event (no. 6) wherein Narendra and Mr. Raghuvanshi engaged in an animated dialogue on the working of an "eliminator." In this exchange, Narendra could not have asked the teacher why one does not get an electric shock from an eliminator if he did not have knowledge, gained outside school, about eliminators. On the other hand, in a communicative event (no. 3) presented earlier, we saw students responding passively to their teacher's instructions and questions on solar cell—a topic that was not that well amenable for understanding and communication with the help of out-of-school discourses. Also, I found that the students that did not have much experience working with electrical circuits at home did not participate much in the class discussions. Most girl students, for instance, did not possess much experiential knowledge of household electric circuits, and thus participated in these class discussions mostly as passive listeners. The fact that students did not use school science discourse in this event or in other events where they acted as passive learners does raise questions about the amenability of school science discourse for appropriation by the students.

In summary, results show that the students accomplished the social work of participating in activities of the science classroom differently in different learning contexts. When the topics did not connect with their own experiences, they chose to conform by playing a much more passive role as students. However, if the topic was related to their experiences outside school, while responding to teacher's questions and comments, they responded with utterances that sought to dialogize school science discourse with out-of-school discourses and experiential knowledge on electricity. On such topics, I also found students taking initiative to influence the nature and direction of classroom dialogues on school science. These initiatives were aimed at helping students connect school science discourse with their own out-of-school discourse and experiential knowledge on electricity, and gain a more coherent understanding of these topics through reconciliation of their home-grown knowledge with school science. This expression of student agency was local and contingent as it crucially dependent upon the local teaching-learning context and the contingent availability of circulating discourses for agentive action. Their out-of-school discourse and knowledge of electricity was one resource the students consistently used to stage agentive

action. As the results indicate, through such agentive action students tried to appropriate school science and make it relevant to their own experiences with electricity outside school.

LIMITATIONS

This study was an attempt at immersion in students' worlds in order to understand how they experienced and perceived the events occurring in their lives (Emerson et al., 1995). Such an attempt is necessarily ambitious as it seeks to capture and inscribe fast-moving events in a hectic, complex social world of which the researcher because of her outsider's status has only limited understanding. As such ambitions are difficult to realize in practice, this study is defined as much by its limitations as by its success in offering the reader a narrativized glimpse into the lives of students in Rajkheda.

A prominent limitation that restricts the scope of this study was poor access to lives and thoughts of girl students in Raghuvanshi's class. I had hoped to better study how science instruction gets gendered in a school like Rajkheda. However, the girl students in eighth grade were now of an age when social norms, especially in rural areas of that region, encourage girls to become wary of contact with outsiders like me. Although there were a few girls that overcame these restraints and offered me as much access to their experiences and lives as the boys, most girls were shy and restrictive in talking with me.

This study was an effort to represent the voices of the underprivileged students in a village in India. Through this study I wish to speak for them as their voice goes largely unheard in the current discourse on education in India. However, as Spivak (1988) reminded intellectuals engaged in such efforts, I run the risk of doing "epistemic violence" to the participants of this study by revoicing their desires, actions, and meanings through this study. This is so because, as Spivak cautioned, by speaking for them I may be reinscribing their subordinate position in the society, and furthering their dependence on someone else, an outsider, and a member of a social class that has traditionally oppressed them to speak for them.

Lastly, it deserves to be mentioned that this paper presents only a partial portrait of students' response to school science discourse as it does not dwell much on the role of the teacher in coconstructing the communicative events. Mr. Raghuvanshi did much to encourage expression of students' agency for sake of science learning. A more complete portrait of student action in a classroom, thus, would locate agency in an intersubjective realm populated by several actors and shared discursive means (Bhabha, 1994; Wertsch, Tulviste, & Hagstrom, 1993).

DISCUSSION

The eighth-grade students of Rajkheda middle school stepped into Mr. Raghuvanshi's science class with extensive, useful, and situated funds of knowledge about the material world (Moll et al., 1992). There, in order to survive and successfully negotiate their roles, students had to accomplish the social work of engagement in activities of the science classroom. This was an engagement that was mediated by circulating discourses in the social setting of a classroom community. The study shows that they performed this role, using resources as their disposal, in a varied and contingent manner.

For much of the class time, students negotiated their roles as passive learners by not taking any initiative and following their science teacher's lead. Although, whenever the topic resonated with their daily life experiences, students made extensive use of their out-of-school discourses and experiences with material world in structuring and giving substance to their responses. Students also depended heavily on their out-of-school discourse in

taking initiative in the classroom. In a study on use of students' everyday experiences in an American urban elementary science classroom, Upadhyay (2006) came to a similar conclusion, viz. students bring their different funds of knowledge accumulated through their everyday experiences into the classroom, and much meaningful science learning resulted when the teacher integrates students' experiences in her teaching of science topics. Likewise, a study done by Smardon (2004) showed that students sometimes used "the code of the street" to enhance their learning achievements in a science class. These researchers are in good company as some other researchers have also noted the learning potential of such crossing of boundaries and interactions of different discourses in a common space (Gutierrez, Rymes, & Larson, 1995; Heath, 1983; Varelas, Becker, Luster, & Wenzel, 2002; Warren et al., 2001). In language learning, Dyson (1996, 1997, 2003) has consistently shown the immense learning potential of permeable curricula that invite students' everyday discourses into the classroom. Thus, in this respect, this study adds one more voice, from India, in favor of the pedagogical practice of encouraging a dialogization of students' unofficial discourses with the official school science discourse in the science classroom.

This paper depicts students' response to school science discourse as more nuanced and varied than often depicted in educational research. Ever since Willis's (1977) seminal work in ethnography that showed how working class "lads" in England resisted and rebelled against the perceived agenda of schooling, there has been a slew of studies purporting to show student agency largely as resistance and rebellion (Barton, Ermer, Burkett, & Osborne, 2003; Carlone, 2003; Foley, 1991; Gilbert & Yerrick, 2001; Seiler, 2002; Seiler, Tobin, & Sokolic, 2001; Taylor, 2003; Zembylas, 2003). However, my research with Rajkheda middle school kids shows that students' responses to school-bound authoritative discourses, such as school science discourse, are far more complex and nuanced than simple opposition and rebellion. Depending upon the contingencies of the moment, students chose to conform to teacher's agenda and instructions or take initiative to influence the direction and outcome of ongoing classroom discussion. These students were "working-class lads" from India who are generally ill-served by the Indian public education system. However, by actively appropriating school science discourse whenever they could and passively negotiating their role as students whenever school science appeared remote to their lives and concerns, they responded to school science in a more varied and tactical manner than simple resistance or rebellion.

de Certeau (2002) in his book *The Practice of Daily Life* has written about how people in everyday life often respond to dominant discourses that they cannot escape from not by rejecting or altering them but by using them creatively for their own purposes. Likewise, students in Mr. Raghuvanshi's science classroom were in no position to escape school science if they wanted to graduate from middle school. They too responded to school science by conformity that was nonetheless marked by a selective appropriation aimed at addressing their own ends and concerns. This paper thus supports the view prevalent among culture theorists and ethnographers that not only is pure resistance an abstraction as human motivations are always complex and contradictory but also human responses to hegemony are far more improvised and creative than simple resistance (Holland et al., 1998; Levinson & Holland, 1996). Furthermore, in this study, human agency comes across as a contingently emergent feature of situated local action. The students did not *have* agency, but rather under opportune circumstances, they *enacted* or *exercised* agency through their participation in the socioculturally mediated dialogues in the classroom.

The fact that students took initiative to influence the nature and direction of their learning experiences on topics that spoke to their everyday experiences outside school indicates that they were eager to appropriate school science discourse if it was relevant to their concerns and lives. Although the school science discourse did not offer them such opportunities in

abundance, the paper does carry a message a hope as it shows how much more meaningful and enriching education can be made for students coming from the traditionally deprived backgrounds if school science discourse tries to harness the "the potentially profound continuities between everyday and scientific ways of knowing and talking" to make school science a communal resource open, accessible, and useful for all students (Moll et al., 1992; Warren et al., 2001). If that happens then, as Anyon (1981) argued, schooling for such kids would actually have not just reproductive but transformative aspects as well.

For the vast majority of rural poor eking out a living on a subsistence level and barely managing to physically survive, school and the education it provides is often the only hope for a better future (Rampal, 2004). To cater to their educational needs, the Indian state and society has accorded high priority to providing universal access to schooling. That is good, and worthy of commendation. However, though necessary, easy access to schooling is hardly sufficient to ensure a better future. This paper supports researchers and educators, such as Rao (2000), Aggarwal (2002), and Roy and Khan (2003), who argue that unless sustained efforts are made to improve the quality of educational experiences students have at school, kids will continue to face daunting challenges in carving a better future for themselves. This study thus recommends a science education that enables rural kids to acquire better tools to understand, question, and manipulate the material world around them. This will help them carve out a better life for themselves in their own villages. It will help them become better homemakers, farmers, and cattle owners. And more importantly, by encouraging and empowering their innate sense of inquiry, such a type of science education will also help them question the status quo, the existing socioeconomic inequities that work to keep them where they currently are, and work toward bringing about peaceful progressive social change. Thus, as Barton et al. (2003) have also argued, this study recommends a science education in particular and education in general that acts as a force for restoring social justice through peaceful means to marginalized sections of the Indian society.

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